Toolbox for the Modeling and Analysis of Thermodynamic Systems (T-MATS)
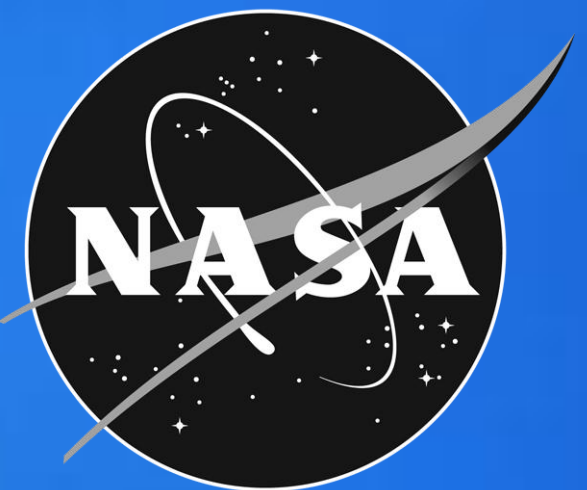
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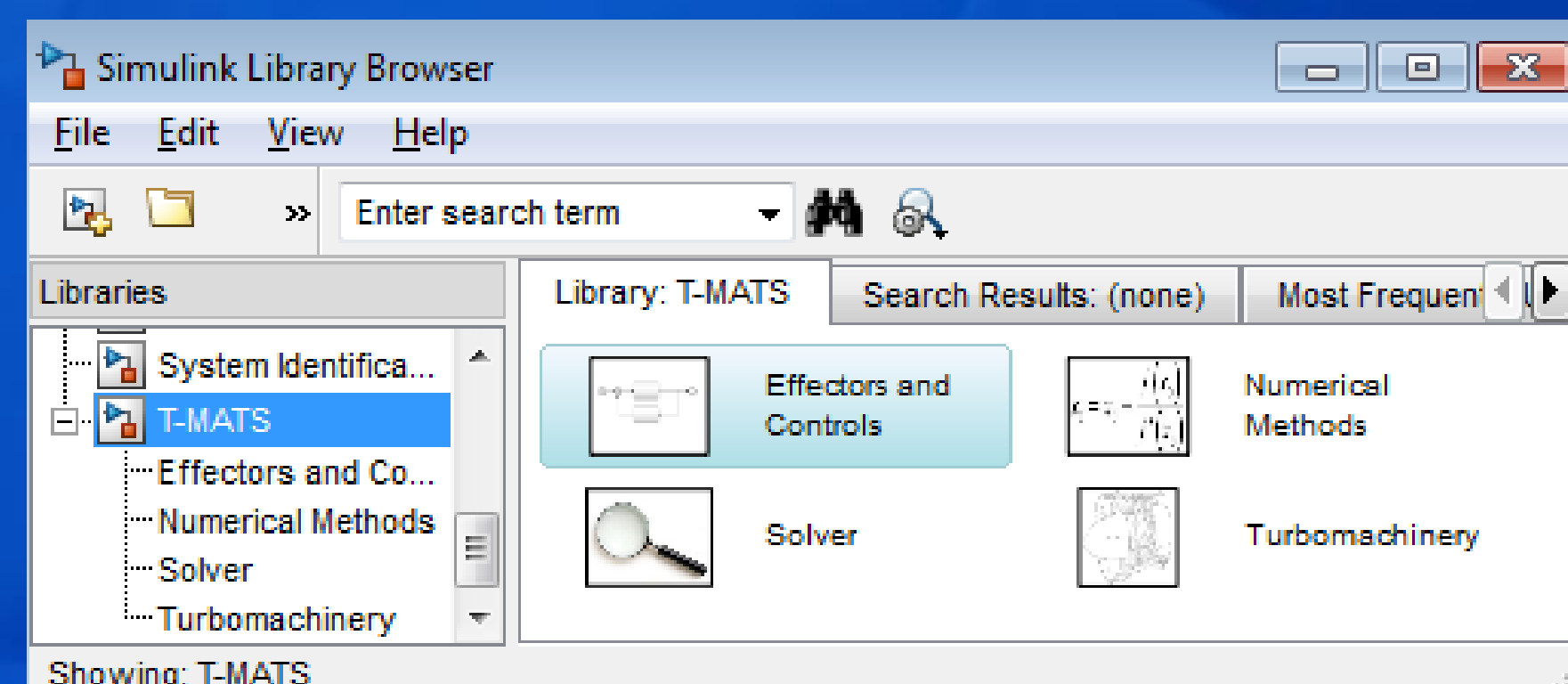
T-MATS Description

Toolbox for the Modeling and Analysis of Thermodynamic Systems (T-MATS)

- Simulation System designed for custom thermodynamic Component Level Model (CLM) creation
- MATLAB/Simulink library structure allows user maximum flexibility
- Open source format encourages open collaboration

Simulation Framework

T-MATS simulation framework uses iterative solvers in the creation of multi-looped systems in Simulink. Includes:

- Components for the building of complex thermodynamic model architecture
- Iterative Solver blocks that are both general and flexible
- Advanced turbo-machinery modeling capability
- Control system (hardware and software) modeling block sets

Automated Iterative Solver Algorithms

T-MATS contains the blocks necessary to automatically solve for model parameters
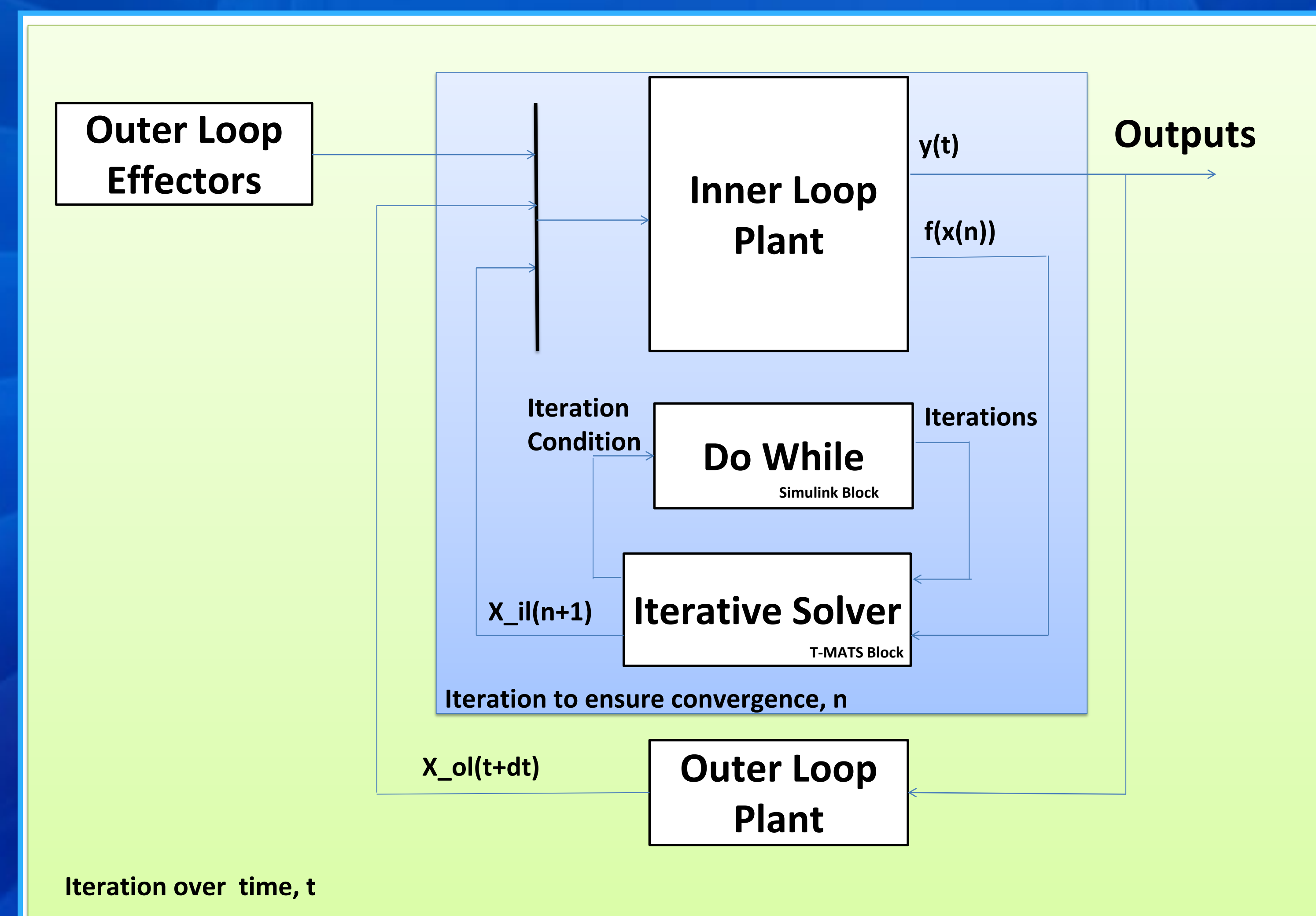
- Solver Blocks, using numerical methods
  - Automated Jacobian calculation

$$J = \begin{bmatrix} \dfrac{\partial f_1}{\partial x_1} & \cdots & \dfrac{\partial f_1}{\partial x_n} \\ \vdots & \ddots & \vdots \\ \dfrac{\partial f_m}{\partial x_1} & \cdots & \dfrac{\partial f_m}{\partial x_n} \end{bmatrix}$$

  - Newton-Raphson iterative solver

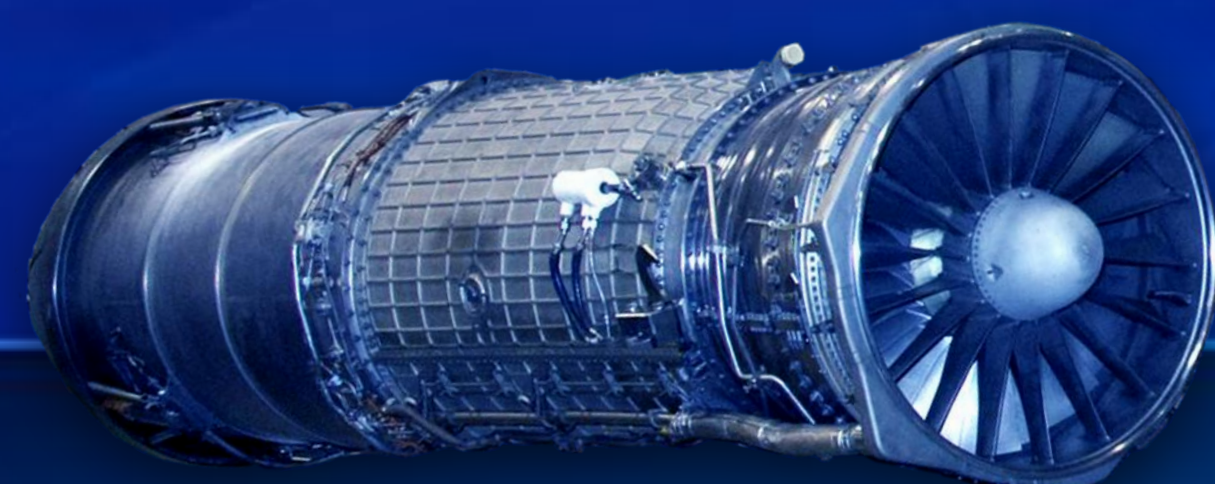$$x(n+1) = x(n) - \frac{f(x(n))}{f'(x(n))} \quad \text{where, } f'x(n) = J$$

T-MATS Simulation Framework

Thermodynamic System Modeling

T-MATS provides Simulink libraries to enable thermodynamic system modeling:

- Turbomachinery library:
  - Provides common turbomachinery component blocks such as compressor, burner, turbine and nozzle
  - Component maps and other block content specified by end user
  - Blocks can be combined to create custom gas turbine engine models such as turbojet and turbofan models
- Effectors and Controls library:
  - Actuator, sensor and control blocks
  - Enables closed-loop system modeling

Example Turbomachinery Library Components
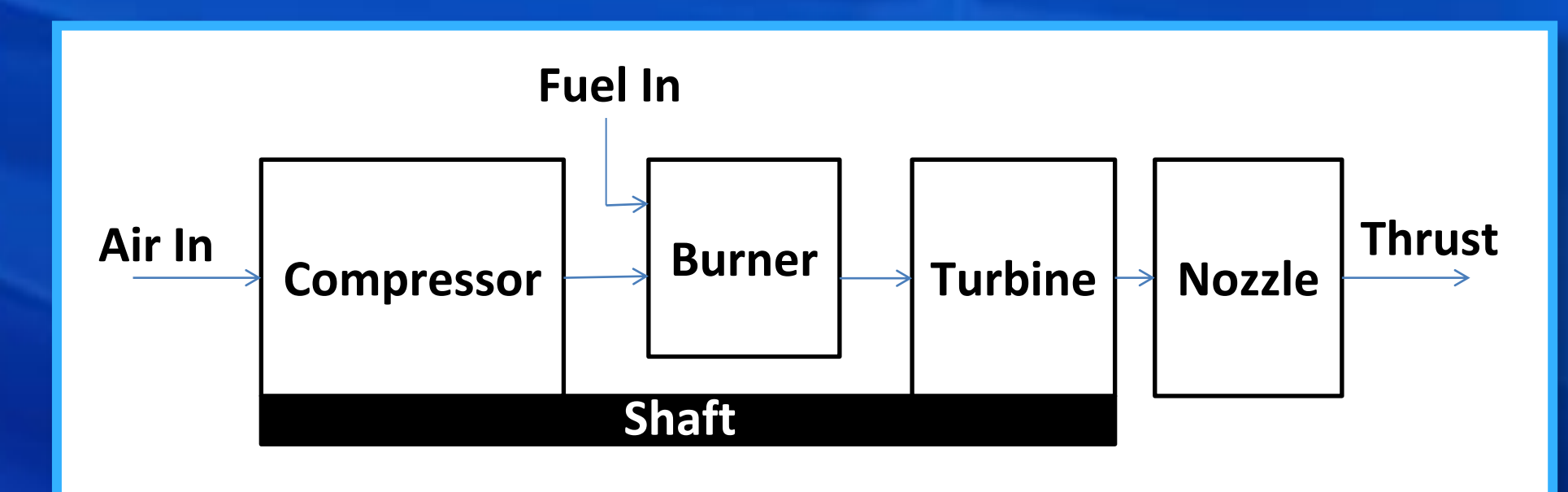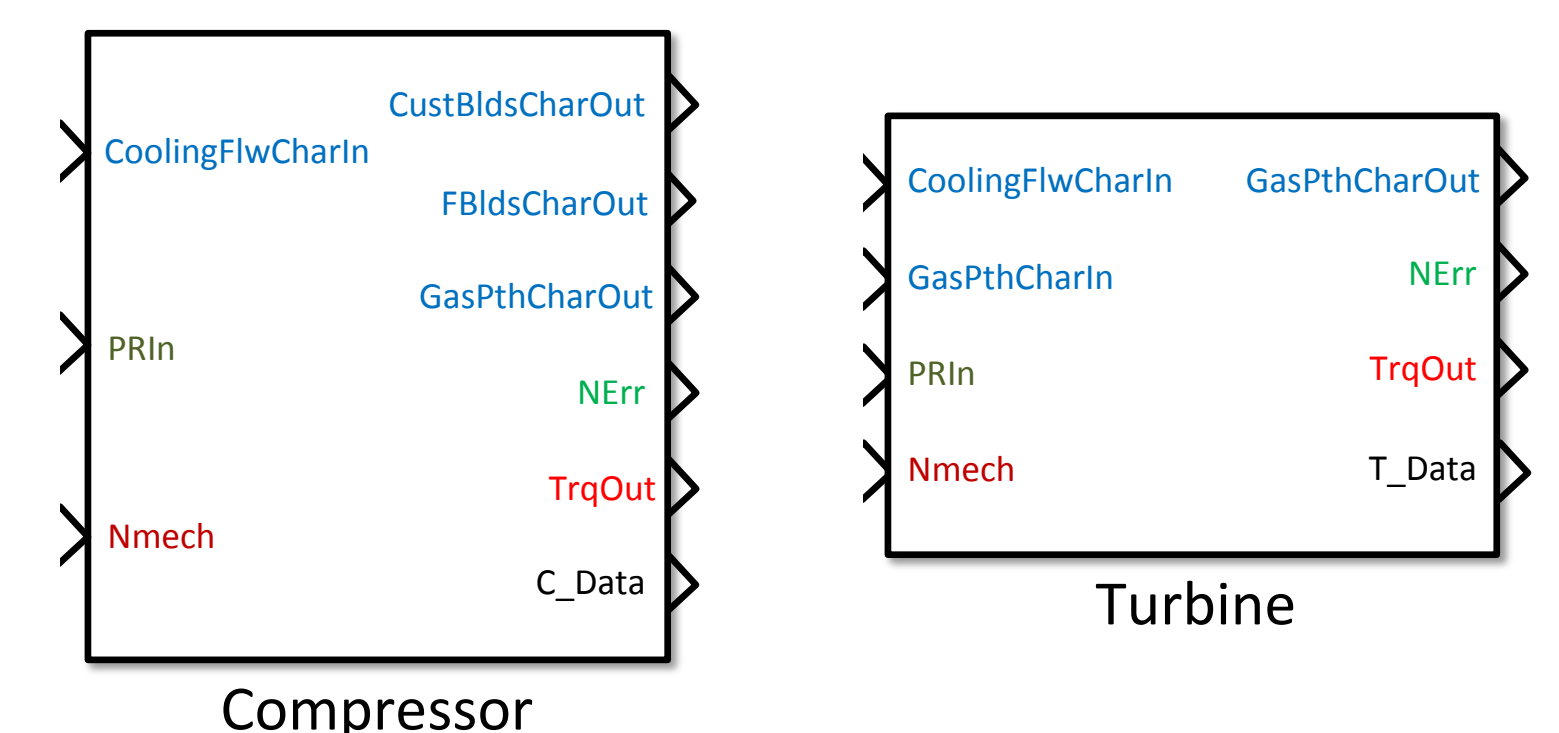
Upcoming Software Release

- Expected release : Q1- 2014

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